

MATURATION OF *PENAEUS VANNAMEI* BASED UPON A SURVEY

JOHN T. OGLE

Fisheries Section, Gulf Coast Research Laboratory,
P.O. Box 7000, Ocean Springs, Mississippi 39564

ABSTRACT Captive maturation and reproduction of *Penaeus vannamei*, a popularly cultured penaeid shrimp, was first achieved in 1977. Based upon interviews of 18 facility managers, average conditions are as follows: tank diameter of 4.6 m (15 ft), 100% water exchange with recirculation, temperature 27-29°C, salinity 28-32 ppt, and a photoperiod of 13-14 hours of light. Broodstock are predominately wild, undergo unilateral eyestalk ablation by enucleation, and are stocked at five per square meter with a 1:1 sex ratio. *Penaeus vannamei* at most facilities are fed squid, pellets and bloodworms four times daily and 3-7% of the females are found to be mated per night and 50% of the eggs are expected to hatch. Most facility managers anticipate some misplaced and some melanization of spermatophores.

INTRODUCTION

Although *Penaeus vannamei* is the most popularly cultured shrimp in the Americas, maturation research has been fairly recent and the species was not matured and reproduced in captivity until 1977 (Aquacop 1979). Effects of diets on maturation were studied by Chamberlain and Lawrence (1981). Maturation in earthen ponds (Yano and Wyban 1987), mating behavior (Yano *et al.* 1988) and hormone treatment (Yano and Wyban 1987, 1988, Yano *et al.* 1988) were also studied. Problems with the melanization of the male spermatophore have been discussed by Chamberlain *et al.* (1983), Leung-Trujillo and Lawrence (1985, 1987), and Salvador *et al.* (1988). The performance in maturation facilities has been reported on by Aquacop (1983), Gomez and Arellano (1987), Wyban *et al.* (1987), McGovern (1988), Ashmore (1988), and Oyama *et al.* (1989). Due to the proprietary nature and competition of the commercial facilities, little information is available as to what constitutes an "industry standard" for maturation of *P. vannamei*. Therefore, a survey was undertaken based upon interviews of maturation facility managers in the Americas and Caribbean basin involved with this species of shrimp.

MATERIALS AND METHODS

While attending the 19th Annual World Aquaculture Society Conference and Exposition, January 2-9, 1988 in Honolulu, Hawaii, interviews were conducted with 18 managers of maturation facilities utilizing *P. vannamei* broodstock. A survey form was used to standardize

questions, although the survey form was not compatible with all responses. The responses were grouped into categories and averaged. Individual responses are not presented in order to comply with concerns of some respondents over the proprietary nature of some information. Not all questions were answered by all respondents, therefore, the averages represent a mean of responses to a particular question and may not add up to 100% for a category. No indication will be made as to which questions were considered sensitive and not answered.

RESULTS

Average conditions under which *P. vannamei* were being matured in 1988 (Table 1) consisted of the use of 4.6 m (15 ft) diameter or greater round tanks which have 100% exchange of recirculated water, with temperatures of 27-29°C, salinity of 28-32 ppt, oxygenated by airstones and the use of artificial illumination with a photoperiod of 13-14 hours daylight. Animals are predominately wild and stocked at five per square meter with a 1:1 sex ratio. Females undergo unilateral eyestalk ablation by enucleation. Three to seven per cent mated females were detected per night by sourcing, with 50% fertilization and some spermatophores were noted to be melanized or misplaced. A combination of feeds were used by all facilities, with squid used by almost all. Pellets were the second most common feed item, with bloodworms ranking third. It should be noted that even though some facilities operated without the use of bloodworms in the diet, all respondents indicated that they would have used bloodworms had they been available to their facility.

TABLE 1
Maturation of *Penaeus vannamei*
a survey of 18 lab managers

SYSTEM	%	ANIMALS	%	FEEDING	%
Tank Diameter		Broodstock		Times per Day	
≤ 12	33	wild	61	2	8
14	11	captive	39	3	38
≤ 15	50			4	54
Daily Turn Over		Eyestalk Ablation		Food	
1x	44	enuclate	61	bloodworms	64
2x	17	cauterize	28	squid	94
5-6x	11	not ablated	6	pellets	71
9-12x	22	Male/Female Ratio		oysters	43
		1:1	81	shrimp	29
Water System		Stocking Density		fish	21
Flow Through	44	≤ 5	38	mussel	14
Recirculating	56	> 5	56	clam	14
Aeration					
Alrstones	65	Mated Female/Night			
Airlifts	29	< 3%	7		
		3-7%	73		
Parameters		> 10%	20		
Temp. 27-29°C	78				
Sal. 28-32 ppt	44	Fertilization			
Activated Carbon	28	< 50%	27		
EDTA	11	> 50%	73		
Lighting		Spermatophores			
Natural Light	33	misplaced			
Photoperiod (13-14)	54	none	8		
		some	84		
Lights Out		a lot	8		
Morning	15	melanized			
Afternoon	23	none	23		
Evening	23	some	69		
		a lot	8		

Bold type indicates average conditions

DISCUSSION

Even though Johnson and Fielding (1956) produced larvae from captive stocks of *Penaeus setiferus* in ponds, routine maturation of penaeids was not achieved until 1975 (Aquacop 1975). A number of penaeid shrimp species have now been routinely matured in captivity. The state of knowledge concerning the published research of shrimp maturation has been adequately reviewed by Muthu and Laxinarayana (1982), Primavera (1985) and Chamberlain (1985).

This survey and summary of conditions, while based

upon a small number of respondents, is useful in providing a beginning toward that which can be considered an "industry standard" in 1988 for captive maturation of *P. vannamei*.

ACKNOWLEDGEMENTS

I would like to thank all the managers for their participation in the survey, Vicki Crain for typing, Jeff Lotz and Kathy Beaugez for reviewing the manuscript, and the USDA CSMR Grants No. 2-2537 and 2-2538 for funding this study.

REFERENCES CITED

- Aquacop. 1975. Maturation and spawning in captivity of penaeid shrimp: *Penaeus merguensis* de Man, *Penaeus japonicus* Bate, *Penaeus aztecus* Ives, *Metapenaeus ensis* de Hann, and *Penaeus semisculcatus* de Haan. *Proc. World Maricult. Soc.* 6:123-129.
- Aquacop. 1979. Penaeid reared brood stock: closing the cycle on *P. monodon*, *P. stylirostris* and *P. vannamei*. *Proc. World Maricult. Soc.* 10:445-452.
- Aquacop. 1983. Penaeid larval rearing in the Centre Oceanologique du Pacifique, p. 123-127. In: J.P. McVey (ed.), *CRC Handbook of Mariculture. Vol. I. Crustacean Aquaculture*. CRC Press, Boca Raton, FL.
- Ashmore, S.B. 1988. Nauplii production results from a commercial *Penaeus vannamei* maturation facility in Hawaii. *J. World Aquacult. Soc.* (Abstract) 19(1):15A.
- Chamberlain, G.W. 1985. Biology and control of shrimp reproduction. p. III1-III41. In: G.W. Chamberlain, M.G. Haby and R.J. Miget (eds.), *Texas Shrimp Farming Manual*. Texas Agricultural Extension Service publication of invited papers presented at the Texas Shrimp Farming Workshop on 19-20 Nov. 1985 in Corpus Christi, Texas.
- Chamberlain, G.W. and A.L. Lawrence. 1981. Maturation, reproduction, and growth of *Penaeus vannamei* and *P. stylirostris* fed different natural diets. *J. World Maricult. Soc.* 12(1):209-224.
- Chamberlain, G.C., S.K. Johnson and D.H. Lewis. 1983. Swelling and melanization of the male reproductive system of captive adult penaeid shrimp. *J. World Maricult. Soc.* 14:135-136.
- Gomez, L. and E. Arellano. 1987. Maturation in captivity of *Penaeus vannamei* in the Escuela Superior Politecnica del Litoral. *J. World Aquacult. Soc.* (Abstract) 18(1):14A.
- Johnson, M.C. and J.R. Fielding. 1956. Propagation of the white shrimp, *Penaeus setiferus* (Linn.), in captivity. *Tulane Stud. Zool.* 4(6):175-190.
- Leung-Trujillo, J.R. and A.L. Lawrence. 1985. The effect of eyestalk ablation on spermatophore and sperm quality in *Penaeus vannamei*. *J. World Maricult. Soc.* 16:258-266.
- Leung-Trujillo, J.R. and A.L. Lawrence. 1987. Observations on the decline in male viability of *Penaeus setiferus* under laboratory conditions. *Aquacult.* 65(3-4):363-370.
- McGovern, K.M. 1988. Management strategies for *Penaeus vannamei* broodstock. *J. World Aquacult. Soc.* (Abstract) 19(1):51A.
- Muthu, M.S. and A. Laxinarayana. 1982. Induced maturation of penaeid prawns - a review. *Proc. Symposium on Coastal Aquacult.* The Mar. Biol. Assoc. of India, pp. 16-27.
- Oyama, R., R. Deupree, M. Edralin, J. Sweeney and J. Wyban. 1989. Individual female *Penaeus vannamei* performance under long term maturation system conditions. *J. World Aquacult. Soc.* (Abstract), 20(1):61A.
- Primavera, J.H. 1985. A review of maturation and reproduction in closed thelycum penaeids. pp. 47-64. In: Y. Taki, J.H. Primavera and J.A. Llobrera (eds.) *Proc. First Intl. Conf. Culture of Penaeid Prawns/Shrimps*. Aquaculture Department, Southeast Asian Fisheries Development Center.
- Salavdor, J.A., B. Jaramillo, Z. Romero, H. Lucien-Brun and D.O.C. Lee. 1988. A comparative analysis of sperm quality, between wild caught males and unilaterally eyestalk ablated regenerated males in a commercial *Penaeus vannamei* maturation facility. *J. World Aquacult. Soc.* (Abstract) 19(1):61A.
- Wyban, J.A., C.S. Lee, J.N. Sweeney and W.R. Richards. 1987. Observations on development of a maturation system for *Penaeus vannamei*. *J. World Aquacult. Soc.* 18(3):198-200.
- Yano, I. and J.A. Wyban. 1987. Induced ovarian maturation and spawning of *Penaeus vannamei* by hormone treatment. *J. World Aquacult. Soc.* (Abstract) 18(1):29A.
- Yano, I. and J.A. Wyban. 1987. Maturation of *Penaeus vannamei* in earthen ponds. *J. World Aquacult. Soc.* (Abstract) 18(1):29A.
- Yano, I., R.A. Kanna, R.N. Oyama and J.A. Wyban. 1988. Mating behaviour in the penaeid shrimp *Penaeus vannamei*. *Mar. Biol.* 97:171-175.
- Yano, I., B. Tsukimura, J.N. Sweeney and J.A. Wyban. 1988. Induced ovarian maturation of *Penaeus vannamei* by implantation of lobster ganglion. *J. World Aquacult. Soc.* 19(4):204-209.
- Yano, I. and J.A. Wyban. 1988. Induced ovarian maturation and spawning of *Penaeus vannamei*. *J. World Aquacult. Soc.* (Abstract) 19(1):75.